

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

Element
performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a direction parallel to the insulating surface; and

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

9. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

selectively providing a first portion of the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

62 crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film, so that a crystallization proceeds from the first portion in a lateral direction to the insulating surface;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film while a third portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the second and third portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the third portion is moved to the second portion in a lateral direction to the insulating surface; and

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

82 end forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

17. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

83 forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

E3 end
patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the second portion of the crystalline semiconductor film;

forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

E4 25. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

selectively providing a first portion of the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film, so that a crystallization proceeds from the first portion of the amorphous semiconductor film in a lateral direction to the insulating surface;

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irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a second portion of the crystalline semiconductor film after the irradiating step, while a third portion of the crystalline semiconductor film is not introduced with the impurity element;

wherein the second and third portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the third portion is moved to the second portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the third portion thereby removing the second portion of the crystalline semiconductor film;

64 end forming an active layer of the thin film transistor using the crystalline semiconductor island,

wherein the second heat treatment is performed in the temperature range not exceeding a glass transition point of the substrate.

45. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

65 forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a

second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

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patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity element into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region; and

forming at least a source region and a drain region by doping an impurity element into third portions of the crystalline semiconductor island,

ES and wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

52. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film comprising silicon over a substrate having an insulating surface;

66 providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

crystallizing the amorphous semiconductor film by a first heat treatment to form a crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby

removing the first portion of the crystalline semiconductor film;

forming a gate insulating film over the crystalline semiconductor island;

forming at least one gate electrode comprising a metal on the gate insulating film;

doping an impurity element into at least a second portion of the crystalline semiconductor island to form a lightly doped drain region;

86 end
forming at least a source region and a drain region by doping an impurity element into third portions of the crystalline semiconductor island;

forming an interlayer insulating film comprising silicon over the gate electrode;

forming an interlayer insulating film comprising an organic resin film over the interlayer insulating film; and

forming a pixel electrode that is electrically connected to the source region or drain region through a contact hole over the interlayer film;

wherein the second heat treatment is performed in a temperature range not exceeding a glass transition point of the substrate.

82. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the first portion is moved to the second portion in a direction parallel to the insulating surface;

patterning the crystallized semiconductor film to form a crystalline semiconductor island in the second portion thereby

removing the first portion of the crystalline semiconductor film; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

88. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

28 and
patterning the crystalline semiconductor film to form a crystalline semiconductor island in the second portion thereby removing the second portion of the crystalline semiconductor film; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

94. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

(1) a forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a direction parallel to the insulating surface;

forming a crystalline semiconductor island by removing the first portion and a part of the second portion; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.

100. (Amended) A method of manufacturing a semiconductor device including at least a thin film transistor, said method comprising the steps of:

forming an amorphous semiconductor film on an insulating surface;

providing the amorphous semiconductor film with an element which promotes crystallization of the amorphous semiconductor film;

performing a first heat treatment to crystallize the amorphous semiconductor;

irradiating a laser light or an intense light to the crystalline semiconductor film;

introducing an impurity element belonging to Group 15 into a first portion of the crystalline semiconductor film after the irradiating step, while a second portion of the crystalline semiconductor film is not provided with the impurity element;

wherein the first and second portions of the crystalline semiconductor film are in contact with the insulating surface over the substrate;

performing a second heat treatment for gettering so that the element contained in the second portion is moved to the first portion in a lateral direction to the insulating surface;

forming a crystalline semiconductor island by removing the first portion and a part of the second portion; and

forming an active layer of the thin film transistor using the crystalline semiconductor island.
